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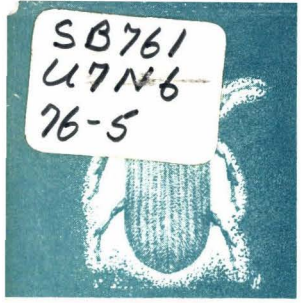

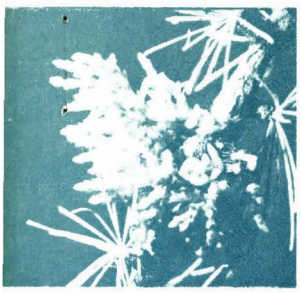

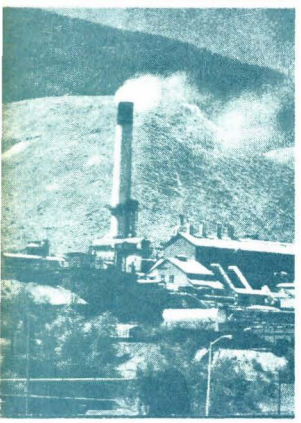

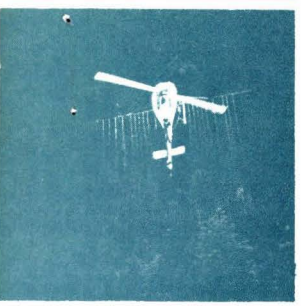

# FOREST ENVIRONMENTAL PROTECTION

**USDA · FOREST SERVICE · NORTHERN REGION**
**State & Private Forestry · Missoula, MT 59801**

Report No. 76-5

5200
April 1976

## EVALUATION OF MOUNTAIN PINE BEETLE INFESTATIONS, GALLATIN RANGER DISTRICT, GALLATIN NATIONAL FOREST MONTANA, 1975

By

M.D. McGregor, D.R. Hamel, and R.C. Lood

### ABSTRACT

Mountain pine beetle has occurred at epidemic level in lodgepole pine stands in the west Gallatin River drainage since 1969. Infestation now encompasses about 5,500 acres. Since 1969, approximately 463,212 trees, with an estimated volume of 20,529,244 board feet have been killed. Approximately 69 percent of the stands on the Gallatin District are classed as susceptible. It is predicted that about 927,781 trees will be killed in 1976. Selective logging to remove infested and susceptible trees is recommended to reduce the potential for a continued epidemic.

### INTRODUCTION

Mountain pine beetle, *Dendroctonus ponderosae* Hopk., developed to epidemic status in lodgepole pine stands, *Pinus contorta* var. *latifolia* Engelm., in the west Gallatin River drainage in 1969.

Number of newly attacked trees increased steadily through 1972, and surveys showed approximately 22,354 trees containing 1,061,722 board feet (212,344 cu.ft.) were killed through 1975.

Direct control in 1970 and 1972, consisting of felling and burning and salvage logging brood trees, had little effect in altering the course of the outbreak. Since suppression was only done on a limited basis, and the majority of infested trees were left untreated, buildup ratio of old to newly attacked trees exceeded 1:1 yearly.

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A significant increase in acreage infested and number of newly attacked trees was detected during the annual insect and disease aerial detection flight in 1975 (Figure 1). Because of the marked expansion in outbreak area, the Gallatin Ranger District initiated operational surveys to determine number of newly attacked trees and volume loss per year, and to delineate areas of most severe infestation. By delineating these areas, salvage logging or selective cutting of the more susceptible trees might be implemented to reduce the epidemic potential in many areas.

## METHODS

Ground surveys were conducted on 5,457 acres (2,208 ha) during November 1975. Variable plots (BA=10) were located at 5-chain intervals on lines 5 chains apart. Spiegal Relaskops were used to tally trees in each plot. All trees 5 inches (13 cm) d.b.h. and larger were tallied in each plot. Data was recorded according to FSM 5200 R-1 Supplement No. 8, July 1972. Survey data were analyzed using a modified Region One timber sale cruise program.

## RESULTS

A total of 29 areas were surveyed (Table 1).

Stand data.--Stands surveyed are mixed, consisting of lodgepole pine, 68 percent; Douglas-fir, *Pseudotsuga menziesii* var. *glauca*, 18 percent; Engelmann spruce, *Picea engelmannii*, 9 percent; and subalpine fir, *Abies lasiocarpa*, 4 percent. Grand fir, white bark pine, and aspen comprise a minor component of the stand. Habitat type varies from *Pseudotsuga menziesii/Symphoricarpus albus* at low elevations to *Abies lasiocarpa/Vaccinium scoparium* at higher elevations (Pfister *et al.* 1974).

Elevation within the infestation ranges from 5,350 to 8,200 feet (1,630 to 2,499 m).

Infestation data.--Estimated tree mortality and volume loss data are shown in Tables 1 and 2. Average d.b.h. of infested trees, percent of lodgepole pine killed, and buildup ratio by year is presented in Table 3.

A total of 463,212 trees with an estimated volume of 20,529,244 board feet (4,105,848 cu. ft.) have been killed during the 6-year period, 1969 to 1975. Size of infested trees ranged from 9 to 20 inches (23 to 51 cm) d.b.h. during that period, average 12 inches (30 cm) d.b.h. A total of 51 percent of the lodgepole pine has been killed in areas surveyed. Buildup ratio of old to newly attacked trees exceeded 1:1 yearly.

In 1975, 56 percent of the trees killed were 10 inches (25 cm) d.b.h. and larger; 53 percent in 1974; 66 percent in 1973; 87 percent in 1972; and 78 percent in 1971. Approximately 62 percent of the remaining green lodgepole pine is 10 inches (25 cm) d.b.h. and larger.

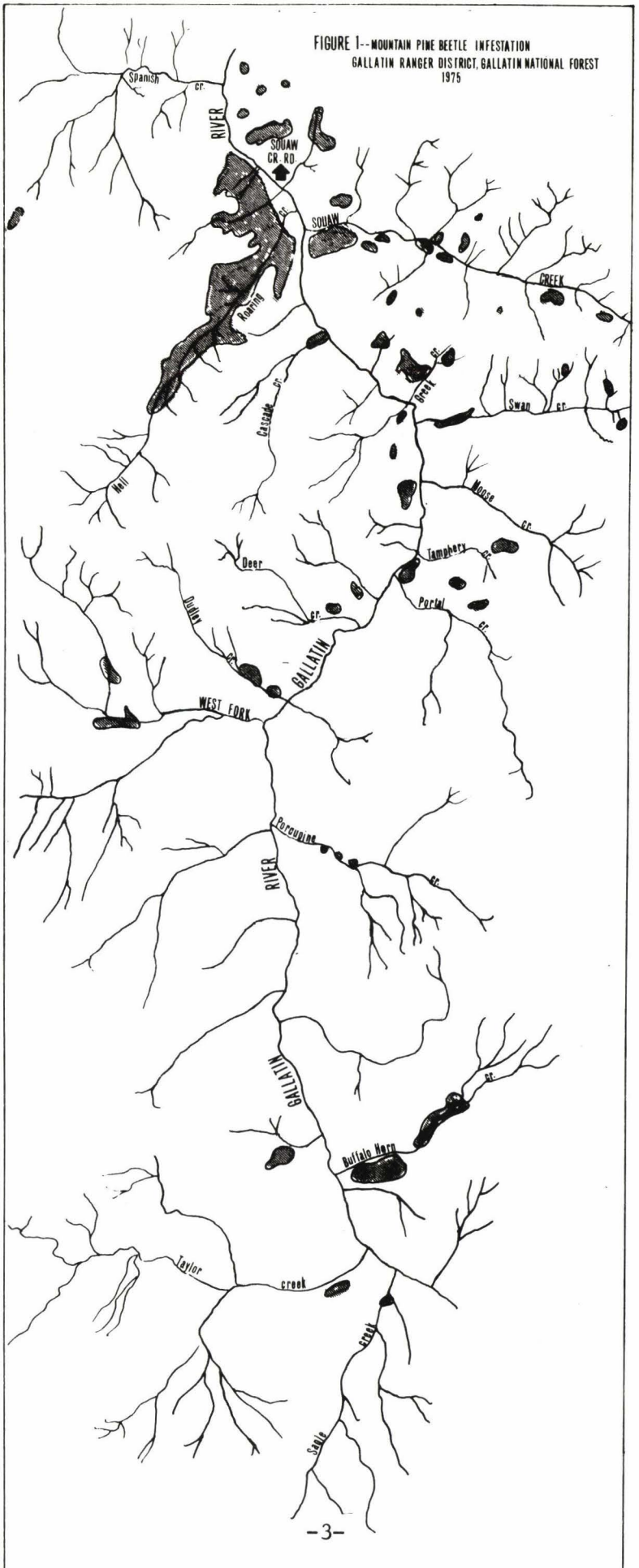
FIGURE 1--MOUNTAIN PINE BEETLE INFESTATION
GALLATIN RANGER DISTRICT, GALLATIN NATIONAL FOREST
1975
Spanish
cr.
RIVER
SQUAW
CR. RD
SQUAW
CREEK
Roaring
Cascade cr.
Swan cr.
Moose cr.
Tamphery cr.
Portal cr.
Deer cr.
Dudley cr.
GALLATIN
WEST FORK
Porcupine cr.
RIVER
GALLATIN
Buffalo Horn cr.
Taylor creek
creek
Sage

Table 1.--Estimated tree mortality, Gallatin Ranger District, Gallatin National Forest, Montana, 1969-1975

| Area surveyed | Acres surveyed/year | | | | | | | Infested trees/acre/year | | | | | | | Total trees killed/year | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
| Indian Ridge | | | | 58 | 58 | | 360 | | 20.8 | 1.2 | 23.4 | 42.6 | 93.4 | 135.6 | | 1,204 | 70 | 1,354 | 15,321 | 32,895 | 48,834 |
| Hell Roaring | | 369 | | 260 | 309 | | 2,700 | 3.0 | 4.5 | 6.4 | 10.8 | 10.3 | 26.0 | 70.9 | 788 | 1,670 | 1,129 | 2,797 | 2,671 | 70,234 | 191,561 |
| Logger Creek | | 138 | | 45 | 45 | | 300 | 3.4 | 19.0 | 11.8 | 6.5 | 25.5 | 19.0 | 88.8 | 469 | 2,617 | 237 | 275 | 1,147 | 5,689 | 26,654 |
| Sheep Rock | | | | | | | 320 | | | | | 2.9 | 3.8 | 4.9 | | | | | 931 | 1,212 | 1,554 |
| Wilson Fork | | | | | | | 140 | | | | | 1.9 | 7.0 | 18.1 | | | | | 262 | 980 | 2,534 |
| West Creek | | | | | | | 30 | | | | | 3.2 | 1.4 | 4.7 | | | | | 97 | 41 | 140 |
| Garnet Mountain | | | | | | | 380 | | | | | 3.2 | 3.9 | 48.1 | | | | | 1,224 | 1,501 | 18,283 |
| Greek Creek | | | | | 30 | 10 | 300 | | | 8.3 | 7.0 | 8.8 | 4.9 | 28.3 | | | 249 | 70 | 88 | 1,469 | 8,492 |
| Upper Dudley | | | | | | | 200 | | | | | 6.7 | 5.6 | 10.3 | | | | | 1,346 | 1,124 | 2,066 |
| Purdy Creek | | | | | | | 30 | | | | | 4.0 | 0.4 | 16.2 | | | | | 119 | 11 | 487 |
| Rat Lake | | | | | | | 20 | | | | | 14.3 | 8.7 | 23.3 | | | | | 286 | 175 | 467 |
| Portal Creek | | | | 35 | 5 | | 40 | | | 22.9 | 11.9 | 7.0 | 29.8 | 8.9 | | | 344 | 178 | 105 | 1,194 | 355 |
| Squaw Line Creek Rd. | | | | | | | 15 | | | | | 9.5 | 3.9 | 20.1 | | | | | 143 | 59 | 301 |
| Mica Creek | | | | | 32 | | 20 | | | | | 4.6 | 0.9 | 0 | | | | | 147 | 19 | 0 |
| Moose Creek | | | | | | | 30 | | | | | 3.6 | 17.1 | 4.7 | | | | | 90 | 428 | 141 |
| Sage Creek | | | | | | | 15 | | | | | 2.3 | 4.6 | 23.2 | | | | | 34 | 69 | 348 |
| Deep Creek | | | | | | | 15 | | | | | 18.9 | 64.8 | 0 | | | | | 283 | 972 | 0 |
| Spanish Creek | | | | | | | 15 | | | | | | 5.5 | 9.0 | | | | | | 82 | 135 |
| Porcupine | | | | | | | 5 | | | | | 2.8 | .2 | 0 | | | | | 14 | 1 | 0 |
| Swan Creek Camp Gr. | | 22 | | 25 | 22 | | 10 | | 0.6 | | 0.6 | 0 | 1.7 | 7.0 | | 13 | | 15 | 0 | 17 | 70 |
| Spire Rock | | | | | | | 10 | | | | | | 0.9 | 4.4 | | | | | | 9 | 44 |
| Buffalo Horn | | | | | | | 270 | | | | | 1.9 | 0.6 | 0.4 | | | | | 502 | 156 | 99 |
| Cascade Creek | | | | | 20 | 10 | 21 | | 2.0 | 1.0 | 2.6 | 1.6 | 1.8 | 17.6 | | 51 | 19 | 25 | 16 | 37 | 370 |
| Swan Creek | | 22 | | 25 | 22 | | 15 | | 0.6 | 0 | 0.6 | 0 | 0.7 | 3.4 | | 13 | 0 | 15 | 0 | 0 | 51 |
| Tamphrey Creek | | | | 40 | 35 | | 10 | | 0.9 | 0.9 | 1.1 | 1.0 | 4.4 | 1.7 | | 38 | 73 | 55 | 10 | 44 | 17 |
| Guest Ranch | | | | | | | 37 | | | | | 9.5 | 4.9 | 3.2 | | | | | 351 | 181 | 117 |
| Trailer Village | | | | | | | 49 | | | | | 6.8 | 16.0 | 9.3 | | | | | 331 | 784 | 456 |
| Asbestos Creek | | | | | | | 25 | | | | | 3.6 | 17.1 | 0 | | | | | 90 | 428 | 0 |
| Cinnamon Creek | | | | | | | 90 | | | | | 3.0 | 1.2 | 0.7 | | | | | 270 | 105 | 64 |
| Total or Average | | 551 | | 518 | 468 | 10 | 5,472 | 3.2 | 6.9 | 7.5 | 7.1 | 7.9 | 12.0 | 22.5 | 1,257 | 5,606 | 2,121 | 4,784 | 25,878 | 119,926 | 303,640 |

Table 2.--Estimated volume loss, Gallatin Ranger District, Gallatin National Forest, Montana, 1969-1975

| Area surveyed | Infested volume/acre (bd. ft.) | | | | | | | Total volume loss (bd. ft.) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
| Indian Ridge | | 1,251 | 118 | 1,837 | 1,752 | 3,269 | 2,997 | | 72,549 | 6,860 | 106,532 | 630,882 | 1,176,998 | 1,078,958 |
| Hell Roaring | | 302 | 379 | 502 | 741 | 1,884 | 2,905 | | 78,573 | 98,501 | 104,563 | 192,565 | 5,085,670 | 7,842,505 |
| Logger Creek | | 546 | 314 | 324 | 1,563 | 5,689 | 2,174 | | 25,390 | 14,116 | 14,567 | 70,337 | 237,317 | 652,288 |
| Sheep Rock | | | | | | 302 | 388 | | | | | | 53,771 | 124,160 |
| Wilson Fork | | | | | 28 | 397 | 760 | | | | | 3,941 | 55,621 | 106,464 |
| West Creek | | | | | 284 | 139 | 421 | | | | | 8,528 | 5,156 | 12,644 |
| Garnet Mountain | | | | | 114 | 225 | 2,265 | | | | | 43,274 | 85,649 | 860,629 |
| Greek Creek | | | 1,011 | 1,494 | 1,638 | 259 | 1,015 | | | 30,319 | 14,942 | 16,383 | 77,667 | 304,560 |
| Upper Dudley | | | | | 568 | 447 | 645 | | | | | 113,682 | 89,362 | 128,909 |
| Purdy Creek | | | | | 153 | 24 | 879 | | | | | 4,587 | 733 | 26,376 |
| Rat Lake | | | | | 1,010 | 772 | 3,320 | | | | | 20,199 | 15,449 | 66,407 |
| Portal Creek | | | 2,565 | 3,239 | 404 | 1,827 | 460 | | | 25,648 | 32,392 | 4,035 | 73,070 | 18,416 |
| Squaw Line Creek Rd. | | | | | 834 | 1,070 | 1,707 | | | | | 12,508 | 16,406 | 25,602 |
| Mica Creek | | | | | 312 | 158 | 0 | | | | | 6,246 | 3,169 | 0 |
| Moose Creek | | | | | 371 | 946 | 321 | | | | | 11,142 | 28,362 | 9,639 |
| Sage Creek | | | | | 76 | 286 | 1,370 | | | | | 1,139 | 4,283 | 20,557 |
| Deep Creek | | | | | 1,028 | 3,615 | 0 | | | | | 15,423 | 54,226 | 0 |
| Spanish Creek | | | | | | 247 | 556 | | | | | | 3,701 | 8,338 |
| Porcupine | | | | | 685 | 7 | 0 | | | | | 3,425 | 34 | 0 |
| Swan Creek Camp Gr. | | | | | 0 | 107 | 557 | | | | | 0 | 1,070 | 5,565 |
| Spire Rock | | | | | 0 | 61 | 426 | | | | | 0 | 610 | 4,264 |
| Buffalo Horn | | | | | 209 | 52 | 69 | | | | | 56,359 | 14,081 | 18,629 |
| Cascade Creek | | 169 | 139 | 215 | 531 | 210 | 1,841 | | 3,289 | 2,784 | 2,153 | 5,312 | 4,402 | 38,632 |
| Swan Creek | | | | | 26 | 55 | 250 | | | | | 646 | 818 | 3,754 |
| Tamphrey Creek | | 42 | 31 | 151 | 0 | 453 | 148 | | 1,665 | 1,095 | 5,285 | 0 | 4,532 | 1,481 |
| Guest Ranch | | | | | 766 | 731 | 327 | | | | | 28,348 | 27,052 | 12,083 |
| Trailer Village | | | | | 531 | 488 | 453 | | | | | 26,040 | 23,915 | 22,192 |
| Asbestos Creek | | | | | 112 | 1,132 | 0 | | | | | 2,799 | 28,300 | 0 |
| Cinnamon Creek | | | | | 200 | 145 | 178 | | | | | 18,002 | 13,012 | 15,981 |
| Total or Average | | 462 | 651 | 1,094 | 581 | 862 | 1,057 | | 181,466 | 179,373 | 280,434 | 1,295,802 | 7,183,136 | 11,409,033 |

20,529,244

Table 3.--Average d.b.h., percent of lodgepole pine killed and buildup ratio by year, 1969-1975, Gallatin Ranger District, Gallatin National Forest, Montana.

| Year | Avg. d.b.h. of infested trees in inches (centimeters) | Lodgepole pine killed yearly (percent) | Buildup ratio old:new |
|---|---|---|---|
| 1969 | 20 in (51 cm) | 0.01 | 1:2.0 |
| 1970 | 11 in. (28 cm) | 3.5 | 1:1.2 |
| 1971 | 10 in. (25 cm) | 3.8 | 1:2.7 |
| 1972 | 13 in. (33 cm) | 3.6 | 1:1.1 |
| 1973 | 11 in. (28 cm) | 9.8 | 1:4.6 |
| 1974 | 10 in. (25 cm) | 8.1 | 1:2.5 |
| 1975 | 9 in. (23 cm) | 22.2 | |
| Total or average | 12 in. (30 cm) | 51.01 | 1:2.0 |

## DISCUSSION

The mountain pine beetle has caused significant mortality of lodgepole pine on the Gallatin District since 1969. Tree mortality increased steadily through 1972, then a sharp increase in number of infested trees (from 18 to 56 per acre) occurred from 1973 to 1975. Average diameter of infested trees did not change appreciably from 1973 to 1975. The pattern of infestation, i.e., average diameter of trees killed and accumulative tree mortality over years of infestation is shown in Figure 2. Although this does not show the same pattern found by Cole and Amman (1969) in mountain pine beetle infested lodgepole pine stands in Wyoming, it does show preference by the beetle for larger diameter trees.

Entomologists studying other infestations have found that besides tree diameter, other factors that are important in governing epidemic infestations of mountain pine beetle in lodgepole pine stands are phloem thickness, stand density, age, habitat type, elevation, and weather conditions (Amman 1972; Cole 1973; Safranyik *et al.* 1974).

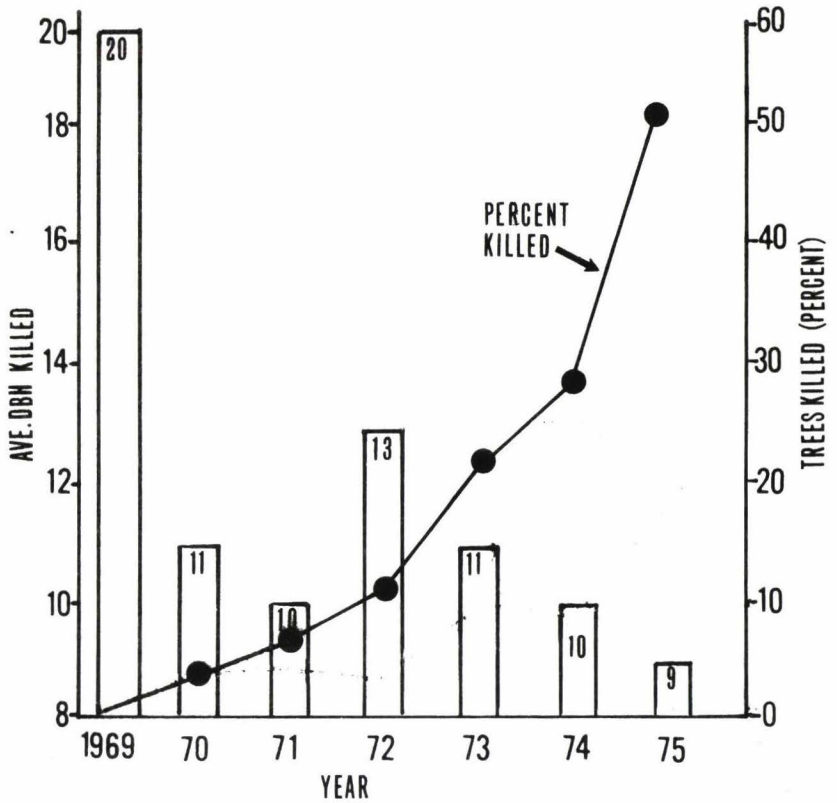


**FIGURE 2** -- PROPORTION AND AVERAGE DIAMETER OF LODGEPOLE PINE TREES KILLED BY YEAR OF INFESTATION IN AREAS SURVEYED

Safranyik *et al.* (1974) used these factors as a basis for hazard rating lodgepole pine stands in British Columbia. A similar map using stand age, density, size and habitat type was prepared for lodgepole pine stands on the Kootenai National Forest, Montana in 1975. Hazard ratings on the Kootenai were prepared for lodgepole pine areas supporting significant lodgepole pine component greater than or equal to 60 years (Hamel and McGregor 1976).

The Gallatin Ranger District prepared a similar map and hazard rated their lodgepole pine stands based on age, density, elevation, and tree diameter (Figure 3). Management priorities were subsequently assigned to lodgepole pine stands as follows:

Priority 1: Highly susceptible; lodgepole is dominant seral, stand age is > 80 years, trees are 11 inches (28 cm) d.b.h. and larger.

Priority 2: Moderately susceptible; lodgepole is dominant seral, stand age is > 80 years, trees are 5 to 11 inches (13 to 27 cm) d.b.h.

Priority 3: Highly susceptible; mixed lodgepole - Douglas-fir, south facing slopes; stand age is > 80 years; trees are 11 inches (28 cm) d.b.h. and larger.

Priority 4: Low susceptibility; lodgepole is dominant seral; stand age is < 80 years; trees are < 5 inches (12 cm) d.b.h., and lodgepole is at the upper end of the size limit.

Priority 5: Low susceptibility; all species over 8,200 feet (2,499 m).

On the Gallatin Ranger District, approximately 56,100 acres were categorized highly susceptible to mountain pine beetle infestation. In this area, 2,097 acres (3.7%) are infested. Approximately 68,176 acres were categorized as priority 2 stands, of which 2,700 acres (3.9%) are infested. In priority 3 stands, 5,640 acres are susceptible, and 1,580 acres (28%) sustain current epidemic infestation. Priority 4 stands comprise 18,627 acres of which 1,148 acres (6%) are infested; however, susceptibility for epidemic infestation is low. Stands in priority 5 classification contain 32,180 acres and only 19 acres (0.05%) are infested. Priority 5 stands are above 2,499 m and are low in susceptibility; however, inflight from epidemic infestation at lower elevation stands will result in some tree mortality in stands at 2,499 m and higher.

Based on buildup ratios from 1974 to 1975, and on the formula $Y' = y+bx$ (Baker 1968) where:

$Y'$ = the potential cumulative number of trees killed predicted through 1974.

$X$ = number of trees killed in 1975.

$X_1$ = number of trees killed in 1974.

$b = \frac{x}{x_1}$

it is predicted that 927,781 trees will be infested in 1976, bringing the cumulative kill through 1976 to 1,231,421. This is about a 1:2 buildup ratio of old to newly infested trees for 1976 in the west Gallatin drainage.

Sufficient acreage of susceptible (Priority 1, 2, and 3) stands (129,916 acres) occur on the Gallatin Ranger District to continue the present infestation at epidemic level for several more years. Susceptible stands make up 69% of the lodgepole type shown in Figure 3.

## RECOMMENDATIONS

Past studies (Amman and Baker 1972) have shown that individual tree control, whether with chemical or by felling and burning, will only extend the years of an infestation and cumulative mortality would probably be comparable with or without direct control.

Methods that have been used for direct control in stands infested with mountain pine beetle are:

1. Treat all infested trees.--This can be effective in slowing impetus of the infestation, but only reduces losses temporarily.

2. Logging.--This requires that every infested tree be cut, removed from the area and processed prior to beetle emergence so stands adjacent to mill yards do not become infested.

3. Salvage logging.--Removal and utilization of dead and/or trees under attack by the beetle. Green trees are usually included in these sales to make them economically feasible.

4. Individual tree protection.--Usually used in high value areas. This method requires spraying of each tree with a protective chemical. No such chemicals are registered at this time.

We recommend that a concerted effort be made to log infested and susceptible stands in the Priority 1, 2 and 3 categories, that do not have management constraints such as:

1. Spanish Peaks Primitive Area and proposed wilderness additions.

2. Inventoried roadless areas which would preclude wilderness until Land Use Planning or the EIS evaluation is completed.

3. The Porcupine - Buffalo Horn area where management prohibits additional road construction. Timber harvest or salvage must be accomplished by other than roading methods except from existing roads.

Priority 1, 2, and 3 stands that can be logged should be reduced to a state of low susceptibility by removing green lodgepole, 10 inches (25 cm) d.b.h. and larger.

Dead and infested trees should be removed from high-use areas prior to beetle flight yearly over the duration of the infestation to reduce hazard to campers.

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Figure 3.--Mountain pine beetle hazard map, Gallatin Ranger District, Gallatin National Forest, Montana, 1976.

- Current infestation boundary.
- Priority 1: Highly susceptible; LPP is dominant seral; stand age is > 80 years; trees 11 inches (28 cm) d.b.h. and larger.
- Priority 2: Moderately susceptible; LPP is dominant seral; stand age is > 80 years; trees 5 to 11 inches (13 to 27 cm) d.b.h.
- Priority 3: Highly susceptible; mixed LPP/Douglas-fir, south-facing slopes; stand age > 80 years; trees 7 inches (28 cm) d.b.h. and larger.
- Priority 4: Low susceptibility; LPP is dominant seral; stand age is < 80 years; trees < 5 inches (12 cm) d.b.h.
- Priority 5: Low susceptibility; all species over 8,200 feet (2,499 m).